LMS/RFS/S04533-0.0

Rocky Flats, Colorado, Site Emergency Response Plan for the Rocky Flats Site Dams

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AM01–07LM00060
for the U.S. Department of Energy Office of Legacy Management.

This page intentionally left blank

LMS/RFS/S04533-0.0

U.S. Department of Energy
Office of Legacy Management

Rocky Flats, Colorado, Site

Emergency Response Plan for the Rocky Flats Site Dams

This page intentionally left blank

Contents

Appendixes

This page intentionally left blank

Acronyms and Abbreviations

cfs	cubic feet per second
DOE	U.S. Department of Energy
DRT	Dam Response Team
LM	Office of Legacy Management
NPH	No Public Hazard
RFLMA	Rocky Flats Legacy Management Agreement
SEO	State Engineer's Office

This page intentionally left blank

1.0 Introduction

The Rocky Flats Site (Rocky Flats) is under the jurisdiction of the U.S. Department of Energy (DOE) Office of Legacy Management (LM). Long-term surveillance and maintenance activities at Rocky Flats are conducted under the Legacy Management Support contract by S.M. Stoller Corporation (Stoller). The Rocky Flats dams are maintained as part of the surveillance and maintenance activities conducted at the Site, which include activities conducted pursuant to the Rocky Flats Legacy Management Agreement (RFLMA). RFLMA established the regulatory framework to implement the final response action selected and approved in the Rocky Flats Corrective Action Decision/Record of Decision under the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; and the Colorado Hazardous Waste Act to ensure the response action remains protective of human health and the environment.

2.0 Purpose

This plan describes response actions required in the event of (1) an actual or potential unplanned release, (2) emergency discharge of water from detention ponds at Rocky Flats (also known as the Site),[1] or (3) the actual or potential failure of a dam. It defines action levels for categorizing conditions up to and including dam failure. This plan supersedes procedure RMRS/OPS-PRO.063, *Action Level Response Plan for Dams A-4, B-5 or C-2.*

Site detention pond dams are earthen structures that are carefully monitored to ensure dam safety. Dams A-4, B-5, C-2, and the Landfill Dam are rated as "Low Hazard" by the State of Colorado. Dams A-1, A-2, A-3, B-1, B-2, B-3, and B-4 are rated as "No Public Hazard (NPH)." State dam classifications range from "High Hazard" (highest concern, loss of human life expected if dam fails) to "NPH" (lowest concern, no loss of human life expected if dam fails; damage limited to dam owner's property). Although an Emergency Action Plan is not required by the Colorado State Engineer for Rocky Flats dams, as a best management practice, a series of action levels and corresponding response actions have been developed to prevent overtopping, uncontrolled discharge, and/or actual dam failure. These action levels and response actions are delineated in this plan.

3.0 Scope

This plan applies to Site contractor, subcontractor, and DOE-LM employees who are tasked with or become involved in response actions affecting the detention pond dams. This procedure addresses action levels and responses used in mitigating actual or potential dam failures and unplanned releases, including emergency spillway discharges. All persons with specific roles and responsibilities are identified herein.

[1] The D-Series Ponds (D-1 and D-2), located in the southeast corner of the Site, are not owned by DOE and thus are not included in this plan.

The following appendices to this Emergency Response Plan are included to provide supporting information:

- Appendix A—data for the subject dams
- Appendix B—pond capacity charts
- Appendix C—piezometer action levels
- Appendix D—flow chart for determining action levels
- Appendix E—guidance on classifying the level of urgency for dam structure issues
- Appendix F—action level response flow charts
- Appendix G—potential problems and emergency actions
- Appendix H—emergency notifications flow chart
- Appendix I—contacts directory and standard notifications
- Appendix J—inundation map for Ponds A-4, B-5, and C-2 in the event of dam failure
- Appendix K—schematic for the current flow and water transfer network at Rocky Flats
- Appendix L—information on environmental water and sediment/soil sampling associated with an unplanned release or emergency discharge from the dams

4.0 Overview

The Site surface water management system includes a series of ponds and dams that retain surface water runoff and control flooding. The system comprises 11 ponds located in three separate drainage basins and the Landfill Pond. Ponds are designated by letters (A, B, or C) indicating its series or group, followed by a number, further identifying the specific pond and dam (e.g., C-2) in the group. All ponds, except the last in the series, are classified as interior ponds. The last pond, designated as the terminal retention pond, becomes the final control point for regulating surface water runoff within a series.

Seven different action levels inform and warn Site personnel of circumstances affecting the integrity of terminal ponds and dams. Action Levels 0 through 2 are referred to as "low" action levels, and Action Levels 3 through 6 are referred to as "high" action levels.

- **Action Level 0** identifies the day-to-day monitoring activities.
- **Action Levels 1** and **2** permit low-level monitoring and observation with increased awareness of the potential development of adverse conditions.
- **Action Levels 3** and **4** provide a guided response to potentially adverse conditions affecting the ponds. Specifically, these levels identify preparatory actions for members of the Dam Response Team (DRT) (Appendix H) and support agencies. The DRT provides technical expertise during incipient stages and later in support of emergency conditions.
- **Action Levels 5** and **6** are implemented when conditions indicate the potential for an unplanned release or once one has occurred from a terminal pond, or conditions indicate

the potential for a structural dam failure is present or has occurred. Either instance may require declaration of an emergency condition.

Water release from a dam failure will likely be a high-volume release in a short time period. High-velocity and high-volume spillway flows will likely cause erosion and scouring of the downstream creek bed.

Water from North and South Walnut Creek (Ponds A-4 and B-5, respectively) and the Landfill Pond will flow into Walnut Creek and into the Broomfield Diversion Ditch (if flow rate is less than 40 cubic feet per second [cfs]), while the internal A- and B-Series Ponds may flow into the next downstream pond during flood conditions.

The Broomfield Diversion Ditch is designed to handle flows up to 40 cfs before overtopping the diversion and entering Great Western Reservoir. Water from Pond C-2 will flow into Woman Creek. A short distance downstream of Pond C-2 is the Mower Ditch Head Gate; the gate is normally closed to direct flow into Woman Creek and the Woman Creek Reservoir. When requested by the City of Westminster, the gate can be opened to redirect flow (partially or completely) into Mower Ditch to provide water for Mower Reservoir.

5.0 Responsibilities

The DRT comprises monitoring, engineering, and supervisory personnel who respond to normal conditions and emergency conditions affecting detention dams (Appendix H). The DRT's responsibilities include:

- Inspecting and monitoring the status of detention ponds and dams to identify conditions adversely affecting the dam (to include incipient stages of dam failure);
- Ensuring availability of essential materials and, if needed, coordinating storage to ensure access in an emergency response;
- Performing monitoring, notification, and assistance in an emergency condition, on-scene assessment, emergency response actions, and issuance of personnel protective measures;
- Providing personnel to operate the equipment and/or open valves, as required;
- Ensuring resources are coordinated with emergency response personnel;
- Monitoring and sampling detention pond water on a routine basis;
- Performing routine pool elevation and piezometer monitoring;
- Performing pond transfers and discharges; and
- Providing pumps and associated materials as required for pond transfers and/or discharges.

Responsible DRT personnel are as follows:

- Dam owner representative—Scott Surovchak (DOE);
- Caretaker/pond operations project engineer—George Squibb (Stoller);
- Superintendent—Jeremiah McLaughlin (Stoller);

- Dam engineer—Mel Madril (Stoller); and
- Field technician—Andy Carpenter (Stoller).

6.0 Review of Plan and Training of Personnel

The DRT will train new personnel in the operation and inspection of the dams and the Emergency Response Plan within 1 month of beginning work. In addition, the DRT will review this plan each year and revise and distribute it as needed.

7.0 Instructions

7.1 Action Level Determination, Actions, and Reporting

The action level for each dam will be determined through monitoring and inspections as listed in this plan and from the Action Level Determination Flow Chart in Appendix D, in conjunction with the guidance for classifying the level of urgency for the dam structure issues provided in Appendix E, and the dam-specific data in Appendixes A, B, and C.

Action level responses will be performed in accordance with flow charts in Appendix F and will include emergency notifications per the flow chart in Appendix H and emergency actions per Appendix G where appropriate. These actions will only be taken when they can be accomplished safely without unnecessary risk to personnel. Materials needed for emergency action will be available at the Site or easily obtainable.

The inundation map in Appendix J is based upon a failure of Dam A-4, B-5, or C-2 during the inflow design flood with the reservoir full to the crest of the dam and the emergency spillway operating. This is the worst possible condition expected. The potential floodplain boundary should be considered as a minimum for evacuation planning purposes. No critical public facilities are in the dam failure floodplain.

The DRT will typically be responsible for determining the urgency of any problems and the action level of the dam and communicating the situation at the dam to the emergency authorities for emergency conditions. Other participants will notify their parties in accordance with the Emergency Notifications Flow Chart (Appendix H). The DRT will determine when a dam's action level can be downgraded. The DRT or dam owner's representative will notify the emergency authorities when the emergency is over. Dam structure issues will be reported to the dam engineer immediately upon observation. The dam engineer will generally be the one responsible for determining the urgency of any problems. The engineer will also be responsible for at least the initial monitoring of these types of conditions and may delegate monitoring responsibilities to other DRT personnel.

Under Elevated Awareness Conditions, a weekly status report will be submitted (via e-mail) to those parties listed under Standard Notifications by the DRT. The DRT may submit more frequent status reports at its discretion.

7.2 Monitoring Plan

7.2.1 Visual Observation

The dams will, at a minimum, be visually observed at least once a month when the reservoir is at less than half-full storage capacity, and twice a month when the reservoir is at greater than half-full storage capacity, immediately after heavy flooding, and following an earthquake. Visual observation of the dams will occur when pond elevation and piezometer level monitoring is conducted and will be performed by DRT personnel. The visual observation will include evaluation of the dam structure for issues listed in Appendix E, "Classifying the Level of Urgency for Dam Structure Issues."

7.2.2 Instrumentation Monitoring

Instrumentation will be monitored and the data recorded as described below.

Pond elevations will be field-measured **monthly**, except where an elevated action level for a dam warrants an increased monitoring frequency. Many of the pond elevations can also be monitored remotely using the telemetry system; however, field measurements will still be collected monthly (at a minimum) to ensure the telemetry is properly calibrated and to assess the condition of the dam in the field. DRT personnel will perform pond level monitoring.

Piezometer levels will be field-measured **monthly**, except where an elevated action level for a dam warrants an increased monitoring frequency. Many of the piezometers can also be monitored remotely using the telemetry system; however, field measurements will still be collected monthly (at a minimum) to ensure the telemetry is properly calibrated and to assess the condition of the dam in the field. Piezometer monitoring will be performed by pond operations personnel and evaluated by the pond operations project engineer or dam engineer as an indicator of the level of saturation within the dam embankment or of unusual pore water pressures.

Inclinometers and **crest monuments** will be measured **twice a year**, in June and December, except where an elevated action level for a dam warrants an increased monitoring frequency. The dam engineer will evaluate the results to determine embankment movement, including settlement and slides. DRT personnel will perform inclinometer readings, and surveyors experienced with surveying the dam monuments at the Site will perform crest monument surveys.

7.2.3 Inspections

The dam engineer and/or a qualified consulting engineer will perform thorough inspections once a year for Dams A-4, B-5, C-2, and the Landfill Dam, and every third year for all other dams. These inspections will include field inspection of dam slopes, crests, abutments, spillways, outlet systems, appurtenant structures, and monitoring instrumentation. The inspections will also include monitoring of any seepage, slides, or other structural issues, as well as an evaluation of instrumentation data, as applicable. Results of the inspection, as well as recommendations for repairs and maintenance if necessary, will be reported to the dam owner representative.

This page intentionally left blank

Appendix A

Dam Data

This page intentionally left blank

Table A−1. Rocky Flats Dam Data

DAM NAME	D.O.E. ROCKY FLATS LF	D.O.E. ROCKY FLATS A-1	D.O.E. ROCKY FLATS A-2	D.O.E. ROCKY FLATS A-3	D.O.E. ROCKY FLATS A-4	D.O.E. ROCKY FLATS B-1	D.O.E. ROCKY FLATS B-2	D.O.E. ROCKY FLATS B-3	D.O.E. ROCKY FLATS B-4	D.O.E. ROCKY FLATS B-5	D.O.E. ROCKY FLATS C-2
HAZARD CLASS	LOW	NPH	NPH	NPH	LOW	NPH	NPH	NPH	NPH	LOW	LOW
DAM TYPE	JURISDICTIONAL; SMALL	JURISDICTIONAL; MINOR	JURISDICTIONAL; SMALL	JURISDICTIONAL; SMALL	JURISDICTIONAL; SMALL	NON-JURISDICTIONAL; MINOR	JURISDICTIONAL; MINOR	NON-JURISDICTIONAL; MINOR	NON-JURISDICTIONAL; MINOR	JURISDICTIONAL; SMALL	JURISDICTIONAL; SMALL
DAM ID	20413	25619	25620	20410	25621	25622	25623	25624	25625	25626	25628
NAT ID	2341	2143	973	2100	2243	2669	2670	2671	2672	2244	2245
COUNTY	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON	JEFFERSON
SECTION	2	11	11	11	1	11	11	11	11	12	13
TOWNSHIP	2S	2S	2S	2S	2S	2S	2S	2S	2S	2S	2S
RANGE	70W	70W	70W	70W	70W	70W	70W	70W	70W	70W	70W
PRINCIPAL MERIDIAN	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH	SIXTH
DOWNSTREAM TOWN	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	BROOMFIELD	WESTMINSTER
DISTANCE TO TOWN DOWNSTREAM (MILES)	4	3	3	3	3	3	3	3	3	3	4
STREAM	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WALNUT CREEK	WOMAN CREEK
DAM TYPE	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)	RE (Earth)
DAM HEIGHT (ft)	32	17	27	33	36	8	12	9	8	43	23
DAM LENGTH (ft)	550	185	260	440	1100	200	225	135	200	525	1200
CREST WIDTH (ft)	18	18	36	20	20	30	26	25	25	20	20
CREST ELEVATION (ft)	5926.3	5833.6	5823.1	5799.0	5764.0	5885.0	5875.5	5856.7	5839.8	5810.4	5775.3
SURFACE AREA (acres)	0.7	<0.1	<0.1	1.5	2.8	0.2	0.2	0.4	0.4	1.8	0.9
NORMAL STORAGE (acre-ft)	5.7	<0.1	<0.1	4.4	14.1	<0.1	<0.1	0.4	0.6	11.1	1.6
MAXIMUM STORAGE (acre-ft)	26.8	4.3	18.4	37.9	98.6	2.6	6.7	2.9	0.6	71.0	69.6
DRAINAGE BASIN AREA (acres)	12.6	9.3	51.0	331.0	365.0	9.1	11.5	8.4	282.0	365.0	195.0
MAX. OUTLET CAPACITY (cfs)	10	0	0	33	35	0	0	UNKNOWN	NA	36	40
SPILLWAY TOTAL CAPACITY (cfs)	350	960	780	1200	6600	45	390	615	200	3500	19100
SERVICE SPILLWAY TYPE	NONE	NONE	UCOND	NONE	NONE	NONE	UCOND	UCOND	UCHAN	NONE	NONE
SERVICE SPILLWAY CODE	NONE	NONE	CMP	NONE	NONE	NONE	HDPE	CMP	CONC	NONE	NONE
SERVICE SPILLWAY WIDTH (ft)	NONE	NONE	4	NONE	NONE	NONE	2	4	7	NONE	NONE
SERVICE SPILLWAY FREEBOARD (ft)	NONE	NONE	6.2	NONE	NONE	NONE	6.6	3.7	4.0	NONE	NONE
SERVICE SPILLWAY ELEVATION (ft)	NA	NA	5816.9	NA	NA	NA	5868.9	5853.0	5835.8	NA	NA
EMERGENCY SPILLWAY TYPE	UCHAN	UCHAN	UCHAN	UCHAN	UCHAN	UCHAN	UCHAN	UCHAN	NONE	UCHAN	UCHAN
EMERGENCY SPILLWAY CODE	CONC	EARTH	EARTH	EARTH	EARTH	EARTH	EARTH	EARTH	NONE	EARTH	EARTH
EMERGENCY SPILLWAY WIDTH (ft)	8	20	20	20	150	18	10	10	NONE	80	250
EMERGENCY SPILLWAY FREEBOARD (ft)[1]	5.3	4.5	2.9	6.0	6.1	3.0	4.8	3.7	NONE	6.5	10.0
EMERGENCY SPILLWAY ELEVATION (ft)	5921.0	5829.1	5820.2	5793.0	5757.9	5882.0	5870.7	5853.0	NA	5803.9	5765.3

[1] Values are from original design storm and dam configuration and are not current in all cases

NPH = No Public Hazard

This page intentionally left blank

Appendix B

Pond Capacity Charts

This page intentionally left blank

Table B−1. Pond Capacity Charts

POND A-4
Main Inlet Elev. 5741.3’
Water-Quality Inlet Elev. 5744.9’
Spillway Crest Elev. 5757.9'
Dam Crest Elev. 5764.0'

Elevation (Ft)	Volume (MG)	Capacity (%)
5727.0	0.00	0.0%
5728.0	0.00	0.0%
5729.0	0.00	0.0%
5730.0	0.00	0.0%
5731.0	0.01	0.0%
5732.0	0.04	0.1%
5733.0	0.13	0.4%
5734.0	0.28	0.9%
5735.0	0.49	1.5%
5736.0	0.74	2.3%
5737.0	1.05	3.3%
5738.0	1.43	4.5%
5739.0	1.90	5.9%
5740.0	2.45	7.6%
5741.0	3.10	9.7%
5741.3	3.33	10.4%
5742.0	3.87	12.1%
5743.0	4.76	14.8%
5744.0	5.76	17.9%
5744.9	6.75	21.0%
5745.0	6.86	21.3%
5746.0	8.07	25.1%
5747.0	9.39	29.2%
5748.0	10.82	33.7%
5749.0	12.37	38.5%
5750.0	14.04	43.7%
5751.0	15.86	49.4%
5752.0	17.83	55.5%
5753.0	19.91	62.0%
5754.0	22.14	68.9%
5755.0	24.50	76.2%
5756.0	27.00	84.0%
5757.0	29.64	92.2%
5757.9	32.14	100.0%

POND B-5
Main Inlet Elev. 5785.1’
Spillway Crest Elev. 5803.9'
Dam Crest Elev. 5810.4'

Elevation (Ft)	Volume (MG)	Capacity (%)
5772.0	0.00	0.0%
5773.0	0.00	0.0%
5774.0	0.01	0.0%
5775.0	0.05	0.2%
5776.0	0.12	0.5%
5777.0	0.23	1.0%
5778.0	0.37	1.6%
5779.0	0.54	2.3%
5780.0	0.75	3.3%
5781.0	1.00	4.3%
5782.0	1.29	5.6%
5783.0	1.61	7.0%
5784.0	1.99	8.6%
5785.0	2.42	10.5%
5785.1	2.47	10.7%
5786.0	2.90	12.5%
5787.0	3.45	14.9%
5788.0	4.05	17.5%
5789.0	4.71	20.4%
5790.0	5.43	23.5%
5791.0	6.21	26.8%
5792.0	7.05	30.5%
5793.0	7.96	34.4%
5794.0	8.96	38.7%
5795.0	10.04	43.4%
5796.0	11.21	48.5%
5797.0	12.46	53.9%
5798.0	13.79	59.6%
5799.0	15.19	65.7%
5800.0	16.66	72.0%
5801.0	18.21	78.7%
5802.0	19.83	85.7%
5803.0	21.52	93.1%
5803.9	23.12	100.0%

POND C-2
Main Inlet Elev. 5749.5’
Spillway Crest Elev. 5765.3'
Dam Crest Elev. 5775.3'

Elevation (Ft)	Volume (MG)	Capacity (%)
5745.0	0.00	0.0%
5746.0	0.00	0.0%
5747.0	0.03	0.1%
5748.0	0.13	0.6%
5749.0	0.31	1.4%
5749.5	0.43	1.9%
5750.0	0.56	2.5%
5751.0	0.91	4.0%
5752.0	1.39	6.1%
5753.0	2.00	8.8%
5754.0	2.77	12.2%
5755.0	3.70	16.3%
5756.0	4.81	21.2%
5757.0	6.09	26.8%
5758.0	7.50	33.1%
5759.0	9.04	39.9%
5760.0	10.73	47.3%
5761.0	12.59	55.5%
5762.0	14.62	64.4%
5763.0	16.82	74.1%
5764.0	19.19	84.6%
5765.0	21.80	96.1%
5765.3	22.69	100.0%

Table B−1 (continued). Pond Capacity Charts

POND A-1
Spillway Crest Elev. 5829.1'
Dam Crest Elev. 5833.6

Elevation (Ft)	Volume (MG)	Capacity (%)
5822.0	0.00	0.0%
5823.0	0.00	0.0%
5824.0	0.05	3.8%
5825.0	0.22	16.0%
5826.0	0.45	32.1%
5827.0	0.72	51.6%
5828.0	1.03	73.7%
5829.0	1.36	97.4%
5829.1	1.40	100.0%

POND B-1
Spillway Crest Elev. 5882.0'
Dam Crest Elev. 5885.0'

Elevation (Ft)	Volume (MG)	Capacity (%)
5876.0	0.00	0.0%
5877.0	0.00	0.3%
5878.0	0.05	6.1%
5879.0	0.19	22.6%
5880.0	0.38	44.5%
5881.0	0.60	70.1%
5882.0	0.86	100.0%

POND A-2
Drop Structure Elev. 5816.9'
Spillway Crest Elev. 5820.2'
Dam Crest Elev. 5823.1'

Elevation (Ft)	Volume (MG)	Capacity (%)
5798.0	0.00	0.0%
5799.0	0.00	0.0%
5800.0	0.00	0.1%
5801.0	0.01	0.2%
5802.0	0.04	0.6%
5803.0	0.08	1.3%
5804.0	0.16	2.7%
5805.0	0.28	4.7%
5806.0	0.45	7.6%
5807.0	0.67	11.3%
5808.0	0.95	15.9%
5809.0	1.29	21.5%
5810.0	1.68	28.1%
5811.0	2.13	35.5%
5812.0	2.63	43.9%
5813.0	3.19	53.2%
5814.0	3.81	63.6%
5815.0	4.49	75.0%
5816.0	5.25	87.6%
5816.9	5.99	100.0%
5817.0	6.07	101.4%
5818.0	6.97	116.4%
5819.0	7.94	132.6%
5820.0	8.98	149.9%
5820.2	9.19	153.5%

POND A-3
Spillway Crest Elev. 5793.0'
Dam Crest Elev. 5799.0'

Elevation (Ft)	Volume (MG)	Capacity (%)
5775.0	0.00	0.0%
5776.0	0.01	0.0%
5777.0	0.06	0.5%
5778.0	0.20	1.7%
5779.0	0.42	3.4%
5780.0	0.70	5.7%
5781.0	1.06	8.6%
5782.0	1.51	12.2%
5783.0	2.04	16.5%
5784.0	2.67	21.6%
5785.0	3.39	27.4%
5786.0	4.21	34.0%
5787.0	5.10	41.3%
5788.0	6.08	49.2%
5789.0	7.15	57.8%
5790.0	8.31	67.2%
5791.0	9.56	77.3%
5792.0	10.91	88.2%
5793.0	12.36	100.0%

Table B−1 (continued). Pond Capacity Charts

POND B-2
Drop Structure Elev. 5868.9'
Spillway Crest Elev. 5870.7'
Dam Crest Elev. 5875.5'

Elevation (Ft)	Volume (MG)	Capacity (%)
5862.0	0.00	0.0%
5863.0	0.02	1.3%
5864.0	0.11	7.6%
5865.0	0.29	19.5%
5866.0	0.54	36.4%
5867.0	0.84	56.6%
5868.0	1.17	78.6%
5868.9	1.48	100.0%
5869.0	1.52	102.4%
5870.0	1.90	127.9%
5870.7	2.18	147.1%

POND B-3
Riser Elev. 5849.2'
Spillway Crest Elev. 5853.0'
Dam Crest Elev. 5856.7'

Elevation (Ft)	Volume (MG)	Capacity (%)
5846.0	0.00	0.0%
5847.0	0.02	2.3%
5848.0	0.12	12.4%
5849.0	0.25	26.6%
5849.2	0.28	29.7%
5850.0	0.40	42.2%
5851.0	0.56	59.3%
5852.0	0.74	78.3%
5853.0	0.95	100.0%

LANDFILL POND
Spillway Crest Elev. 5921.0'
Dam Crest Elev. 5926.3'

Elevation (Ft)	Volume (MG)	Capacity (%)
5896.0	0.00	0.0%
5897.0	0.00	0.0%
5898.0	0.33	3.7%
5899.0	0.35	4.0%
5900.0	0.65	7.5%
5901.0	0.71	8.1%
5902.0	0.98	11.2%
5903.0	1.07	12.2%
5904.0	1.30	14.9%
5905.0	1.44	16.5%
5906.0	1.60	18.3%
5907.0	1.79	20.5%
5908.0	2.01	23.0%
5909.0	2.26	25.8%
5910.0	2.53	29.0%
5911.0	2.76	32.5%
5912.0	3.02	36.5%
5913.0	3.33	41.0%
5914.0	3.77	46.1%
5915.0	4.52	51.7%
5916.0	5.07	58.0%
5917.0	5.68	64.9%
5918.0	6.34	72.5%
5919.0	7.07	80.9%
5920.0	7.87	90.0%
5921.0	8.74	100.0%

POND B-4
Spillway Crest Elev. 5835.8'
Dam Crest Elev. 5839.8'
Flow Through Structure

Elevation (Ft)	Volume (MG)	Capacity (%)
5832.0	0.00	0.0%
5833.0	0.00	1.8%
5834.0	0.03	16.5%
5835.0	0.09	52.3%
5835.8	0.18	100.0%

Note: Capacity charts are included for information only for Pond B-4. Action Levels based on percent capacity do not apply to this dam because it is a flow-through structure.

This page intentionally left blank

Appendix C

Piezometer Action Levels

This page intentionally left blank

Table C−1. Piezometer Action Levels

Dam	Piezometer	Lower Action Level (ft)	Upper Action Level (ft)
A-4	DH-A1	5737	5746
	A4-94-02	5727	5752
	A4-94-03	5729	5750
	DH-A3	5722	5724
	A4-94-11	5724	5730
	A4-94-12	5721	5725
B-5	WH-1	5785	5787
	WH-2	5783	5786
	WH-3	5791	5801
	B5-94-05	5788	5800
	B5-94-06	5791	5800
	WH-4	5758	5760
	B5-94-11	5758	5762
C-2	DH-C1	5754	5763
	C2-94-02	5755	5761
	C2-94-03	5742	5760
	DH-C2	5736	5739
	C2-94-11	5744	5747
	C2-94-12A	5741	5750
	C2-94-13A	5735	5751
A-3	Piezo 1	5769	NA
	046292	5776	NA
	Piezo 2	5765	NA
	046492	5765	NA
Landfill	047292	5907	NA
	047092	5889	NA
B-1	046592	5871	NA
	046792	5869	NA
B-3	046992	5842	NA
	047492	5840	NA

Piezometer action levels for A-4, B-5, and C-2 are based on recommendations in Woodward Clyde *Final Geotechnical Analysis Report for Dam Upgrades (Dams A-4, B-5, and C-2)* November 11, 1994.

Piezometer action levels for the Landfill, A-3, B-1, and B-2 are based on the historical maximum levels within the piezometer and only include a lower action level number.

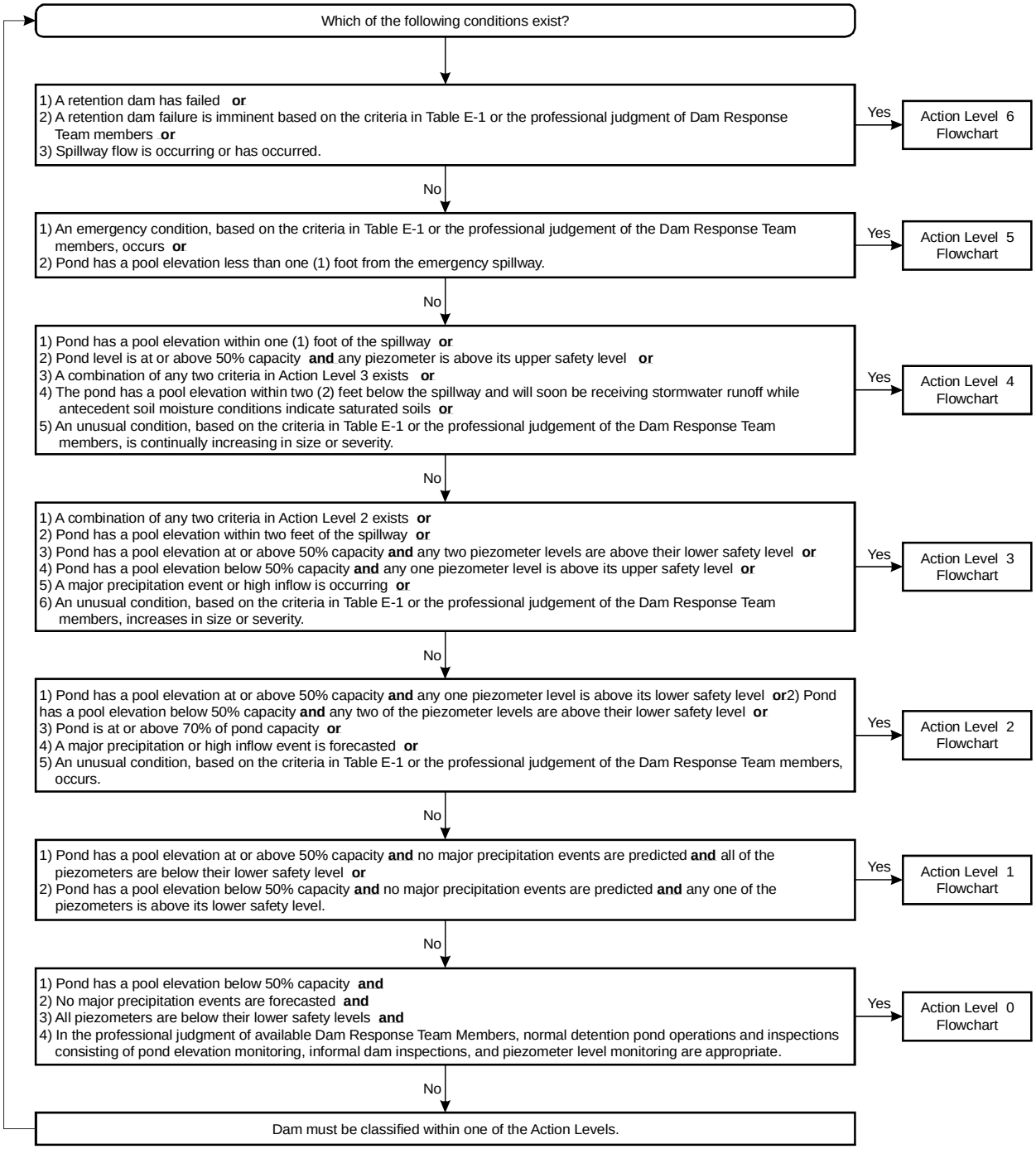
This page intentionally left blank

Appendix D

Action Level Determination Flow Chart

This page intentionally left blank

Table D−1. Action Level Determination Flow Chart



This page intentionally left blank

Appendix E

Classifying the Level of Urgency
for
Dam Structure Issues

This page intentionally left blank

Table E−1. Guide for Classifying the Level of Urgency for Dam Structure Issues

INCIDENT	LEVEL OF URGENCY		
	UNUSUAL CONDITION	**EMERGENCY CONDITION**	**FAILURE IS IMMINENT**
	New or increased problem	Possible failure developing (Stand-by alert, begin mobilizing for failure)	Partial failure, or dynamic failure of dam is in progress (Evacuation should begin)
PROBLEM	**EXAMPLES OF POSSIBLE OBSERVATIONS**		
BACKCUTTING OF SPILLWAY	Erosion of spillway is progressing slowly	Erosion of spillway is progressing rapidly	Spillway has washed out, dam is breached
CRACKING	Dry, open cracks	Cracks with displacement, or minor seepage (clear water)	Significant cracking with muddy seepage
OUTLET FAILURE	Broken gate or operator, rusty, scaling pipe, seepage	Cracked or perforated pipe, sediment in seepage, deeply scoured or undermined conduit	Significant, muddy seepage from or adjacent to outlet; Sinkholes in embankment over outlet conduit
OVERTOPPING OF DAM	Reservoir at crest due to a blocked spillway	Flood overtopping dam causing minor erosion	Flood overtopping dam causing significant erosion
PIPING	Small amount of sediment in seepage or drains	Significant amount of sediment in seepage, drains, muddy water	Seepage has caused large slide which has reduced freeboard to the reservoir level, or dam is overtopping
SEEPAGE	Downstream slope of dam is wet, soft; minor sloughing; water running on ground	Seepage is causing slides which narrows dam cross section, or settlement of crest and loss of freeboard	Seepage has caused large slide which has reduced freeboard to the reservoir level, or dam is overtopping
SETTLEMENT	Minor settlement (less than 1 foot) Small depressions in dam or foundation	Moderate settlement (One-half of freeboard)	Significant settlement, reservoir is overtopping dam
SINKHOLES	Small depressions in dam or foundation	Large hole over outlet, or on dam or foundation. Not increasing	Unstable hole over outlet, or on dam or foundation. Whirlpool in reservoir
SLIDES	Small, or surface slide with minor reduction of dam cross section, and minor crest settlement	Moderate slide which reduces dam cross section, but there is no seepage or overtopping problem	Large slide which reduces dam cross section significantly, with seepage or an overtopping problem
WAVE EROSION OF DAM	Minor erosion of crest height, and/or minor scarping of upstream slope	Moderate erosion of crest height, and/or significant scarping of the upstream slope which is progressing	Significant erosion of crest height and/or rapidly progressing loss of upstream slope
PIEZOMETER LEVELS	An unusual piezometer response occurs based on normal historical responses, or piezometer(s) exceed lower safety levels in an unusual pattern or pattern different than historical levels	Piezometer(s) exceed upper safety levels or are at unusually high levels different from historical levels	Piezometer(s) exceed upper safety levels or are at unusually high levels different from historical levels and are accompanied by seepage, piping, or slides as indicated above

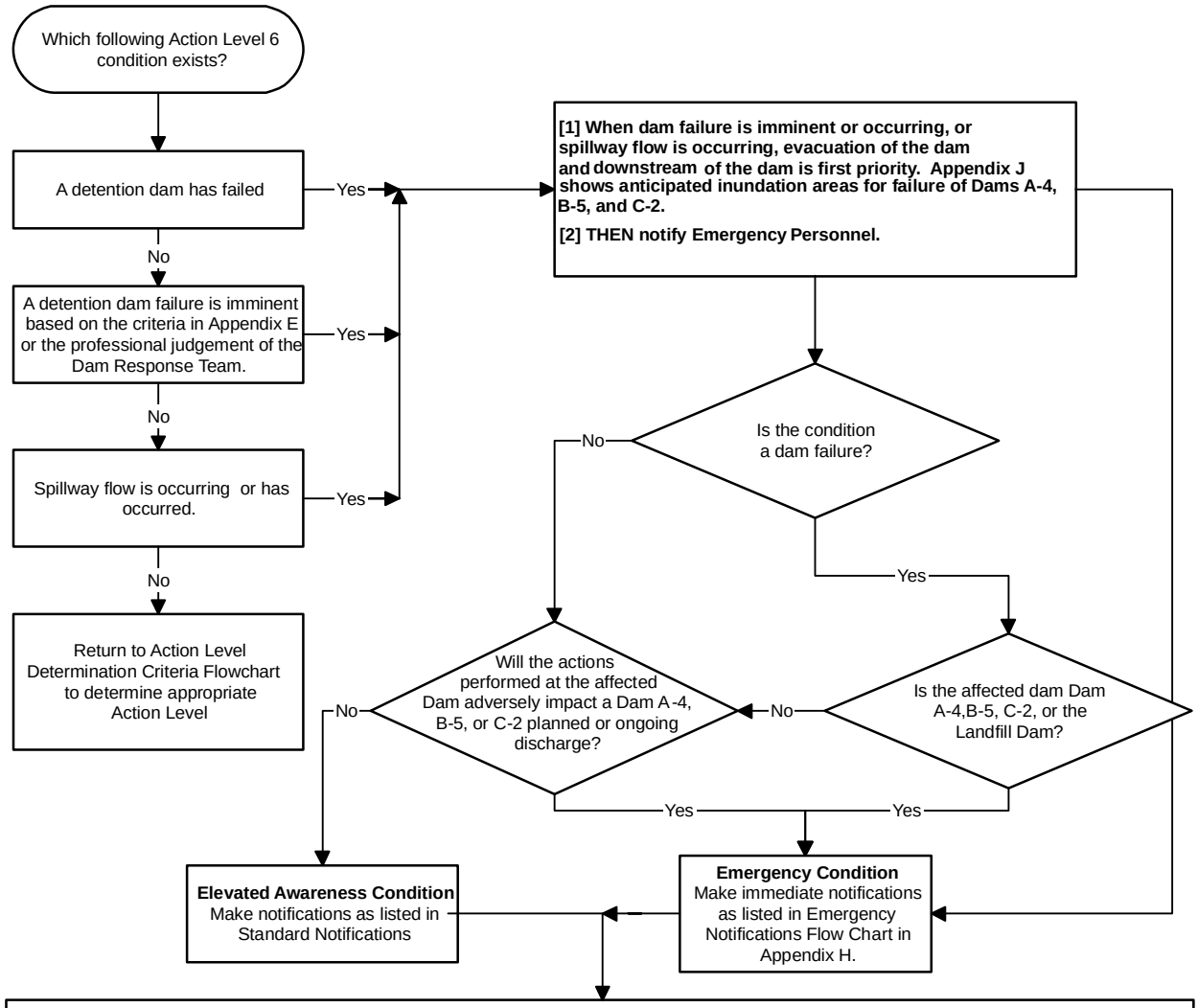
This page intentionally left blank

Appendix F

Action Level Response Flow Charts

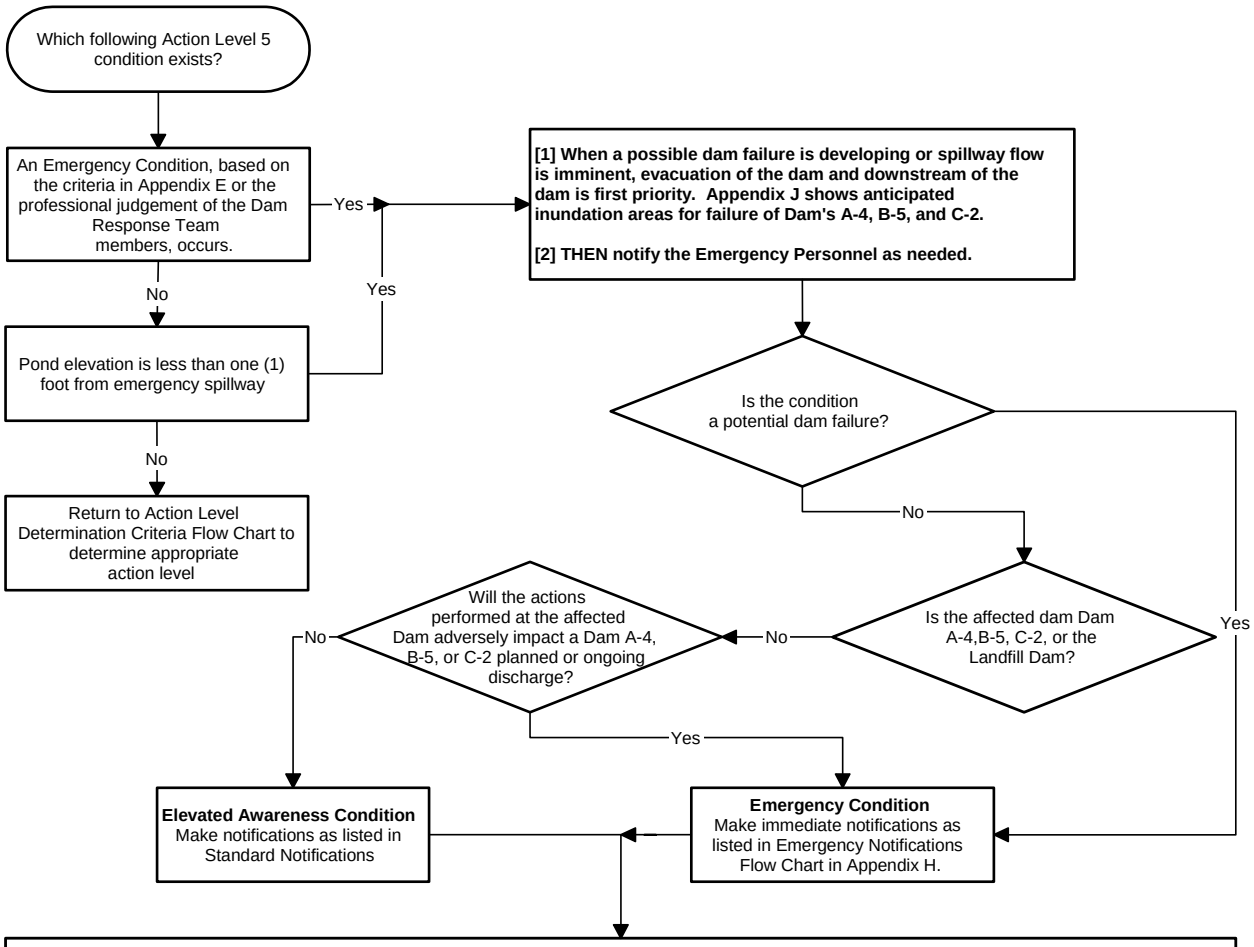
This page intentionally left blank

Action Level 6 Response Flowchart



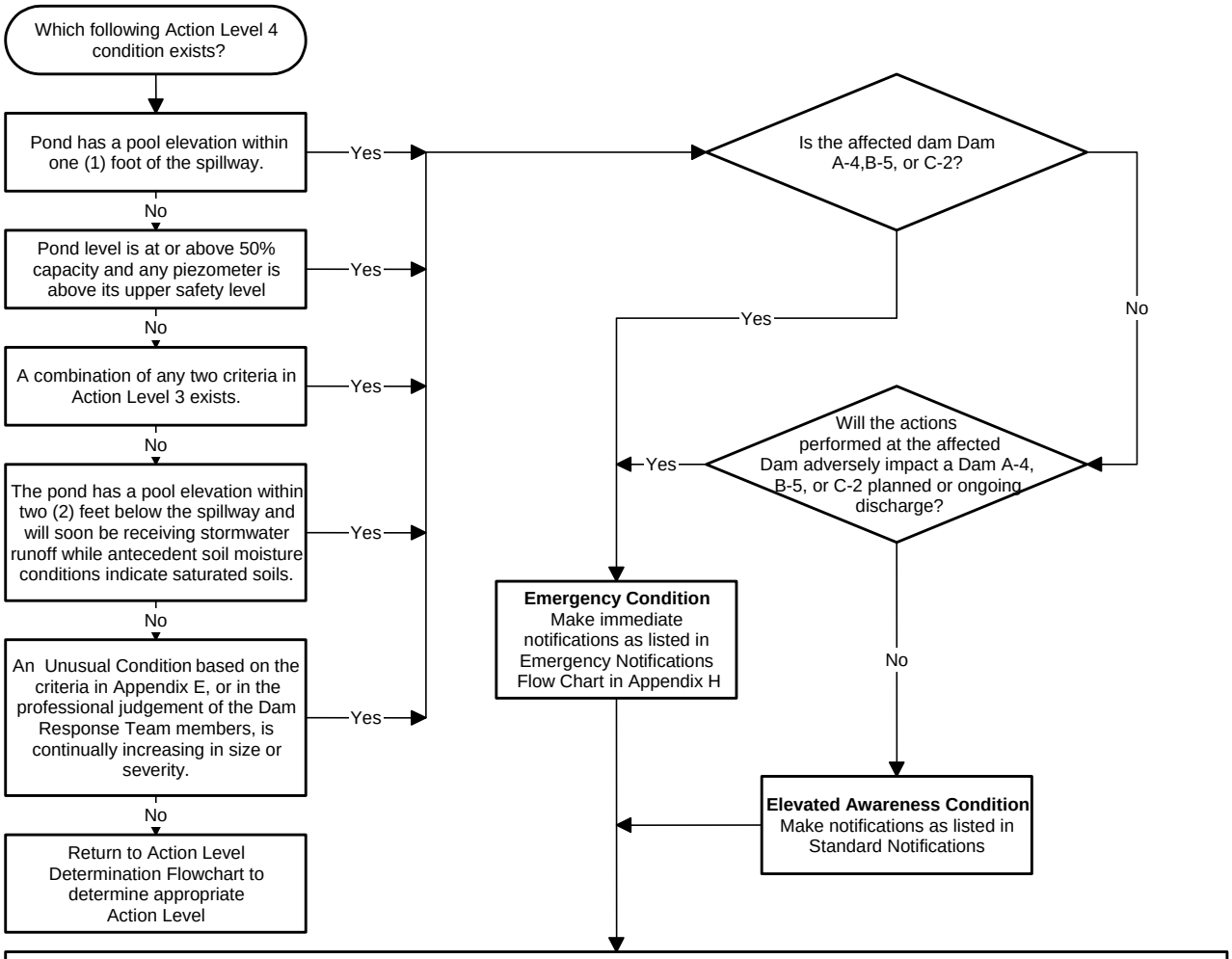
Dam Response Team:
[1] Coordinate with other members of the Dam Response Team and ensure assessment/evaluation of the on-scene situation.
[2] Coordinate on-scene emergency response activities as necessary.
[3] Ensure data for public and employee information development and dissemination is given to appropriate personnel.
[4] Establish safety guidance for personnel collecting samples or working on or below the dam.
[5] Monitor emergency conditions and perform duties as requested by the Dam Engineer and DOE, as applicable.
 [A] Report conditions affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[6] Implement "Emergency Actions" listed in Appendix G, as appropriate.
[7] Establish emergency discharge rates, as feasible.
[8] Provide and operate pumps and associated materials, or operate outlet valves, as required for pond transfers and/or discharges,
 [A] Begin emergency discharge or transfer, with or without sample results, as appropriate.
[9] Coordinate with off-Site agency field monitoring response teams.
[10] Increase dam observation frequency to "continuously".
 [A] Report findings of dam inspections affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[11] Implement environmental sampling as required in accordance with Appendix L, Environmental Water and Sediment/Soil Sampling.
[12] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.
 [A] Evaluate conditions relative to failure modes listed in Appendix E in conjunction with the Dam Engineer and Consulting Engineer (if necessary).
 [B] Coordinate on-Site inspection by the State Engineer's Office to assess the situation and provide recommendations, as appropriate
[13] Change Action Levels, drawdown rate (if approved by the Dam Engineer), inspection frequency, and monitoring activities and frequencies, as circumstances warrant.

Action Level 5 Response



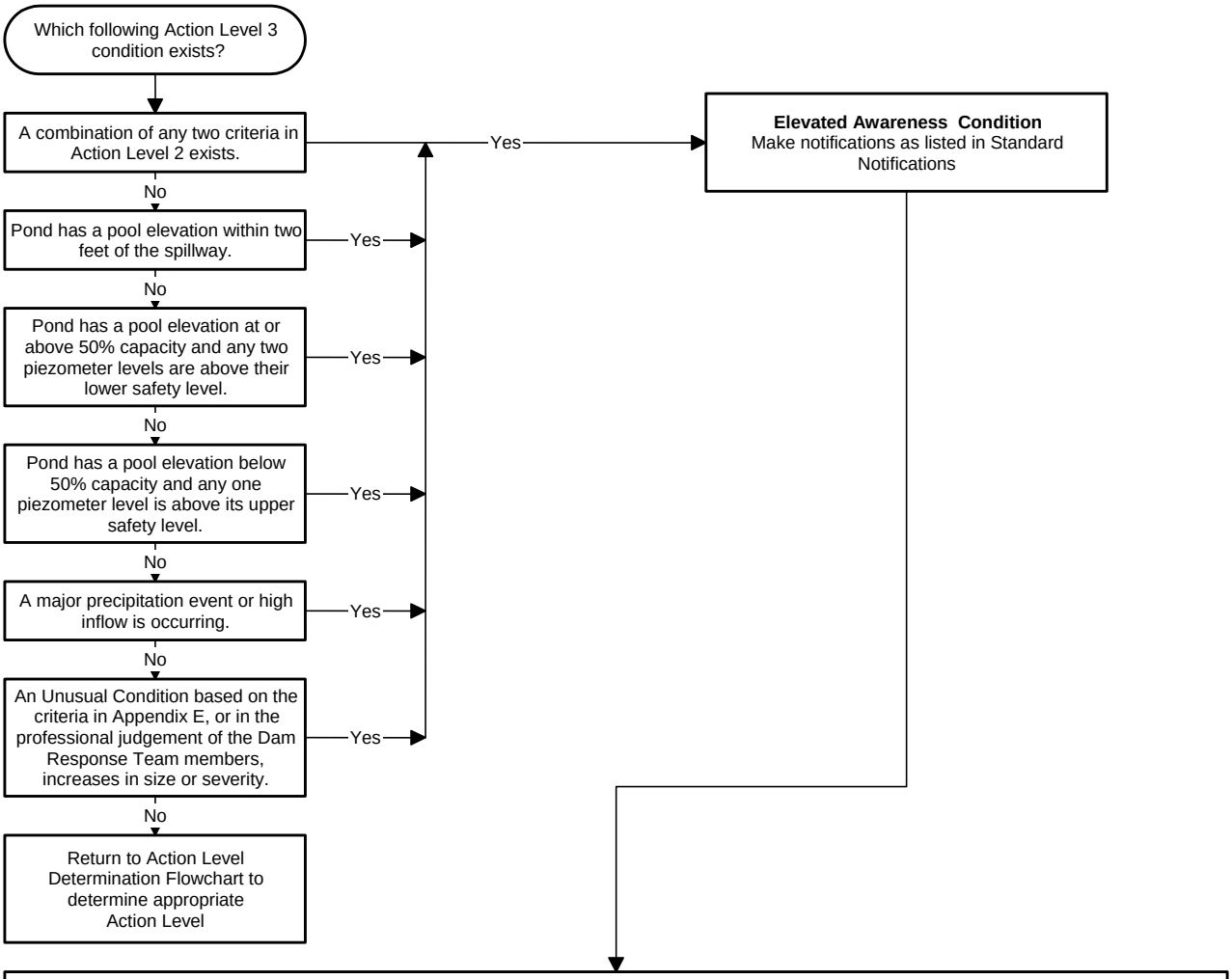
Dam Response Team:
[1] Coordinate with other members of the Dam Response Team and ensure assessment/evaluation of the on-scene situation.
[2] Coordinate on-scene emergency response activities as necessary.
[3] Ensure data for public and employee information development and dissemination is given to appropriate personnel.
[4] Establish safety guidance for personnel collecting samples or working on or below the dam.
[5] Monitor emergency conditions and perform duties as requested by the Dam Engineer and DOE, as applicable.
 [A] Report conditions affecting Action Levels immediately to the Dam Engineer, and DOE, as applicable.
[6] Implement "Emergency Actions" listed in Appendix G, as appropriate.
[7] Establish emergency discharge rates as required to provide a drawdown rate of approximately one foot per day, or more if approved by the Dam Engineer.
[8] Provide and operate pumps and associated materials, or operate outlet valves, as required for pond transfers and/or discharges.
 [A] Begin emergency discharge or transfer, with or without sample results, as appropriate.
[9] Coordinate with off-Site agency field monitoring response teams.
[10] Increase the dam observation frequency to a minimum of every 8 hours.
 [A] Report findings of dam inspections affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[11] Implement environmental sampling as required in accordance with Appendix L, Environmental Water and Sediment/Soil Sampling, as approriate.
[12] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.
 [A] Evaluate conditions relative to failure modes listed in Appendix E in conjunction with the Dam Engineer and Consulting Engineer (if necessary).
 [B] Coordinate on-Site inspection by the State Engineer's Office to assess the situation and provide recommendations, as appropriate
[13] Change Action Levels, drawdown rates (if approved by the Dam Engineer), inspection frequency, and monitoring activities and frequencies, as circumstances warrant.

Action Level 4 Response



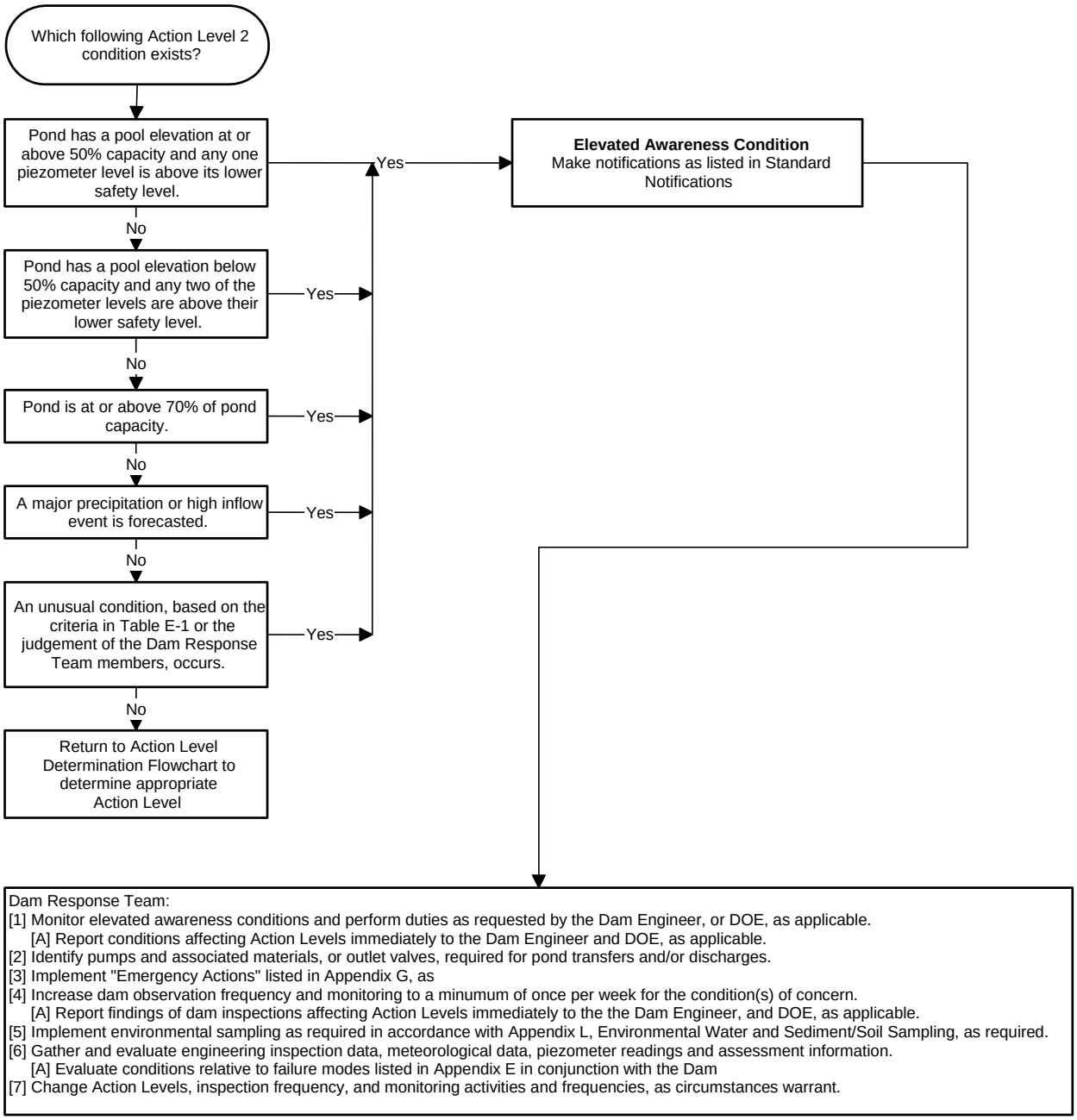
Dam Response Team:
[1] Coordinate with other Dam Response Team and ensure assessment/evaluation of the on-scene situation.
[2] Coordinate on-scene emergency response activities if necessary.
[3] Ensure data for public and employee information development and dissemination is given to appropriate personnel as necessary
[4] Establish safety guidance for personnel collecting samples or working on or below the dam.
[5] Monitor emergency conditions and perform duties as requested by theDam Engineer or DOE as applicable.
  [A] Report conditions affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[6] Implement "Emergency Actions" listed in Appendix G, as appropriate.
[7] Establish emergency discharge rates through the outlet or pumping station at a rate of approximately one foot of drawdown per day,.
  [A] Utilize computer modeling to calculate the flow rates necessary to meet the one foot/day drawdown rate.
  [B] Set pumps or outlet valves to calculated flowrates for the duration of the event or until revised flowrates are calculated.
[8] Provide and operate pumps and associated materials, or operate outlet valves, as required for pond transfers and/or discharges.
  [A] Begin emergency discharge or transfer, with or without sample results, as appropriate.
[9] Coordinate with off-Site agency field monitoring response teams.
[10] Increase dam observation frequency and monitoring to 24 hour intervals, seven days per week.
  [A] Report findings of dam inspections affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[11] Implement environmental sampling as required in accordance with Appendix L, Environmental Water and Sediment/Soil Sampling, as required.
[12] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.
  [A] Evaluate conditions relative to failure modes listed in Appendix E in conjunction with the Dam Engineer and Consulting Engineer (if necessary).
  [B] Coordinate on-Site inspection by the State Engineer's Office to assess the situation and provide recommendations, as appropriate
[13] Change Action Levels, drawdown rates (if approved by the Dam Engineer), inspection frequency, and monitoring activities and frequencies, as circumstances warrant.

Action Level 3 Response

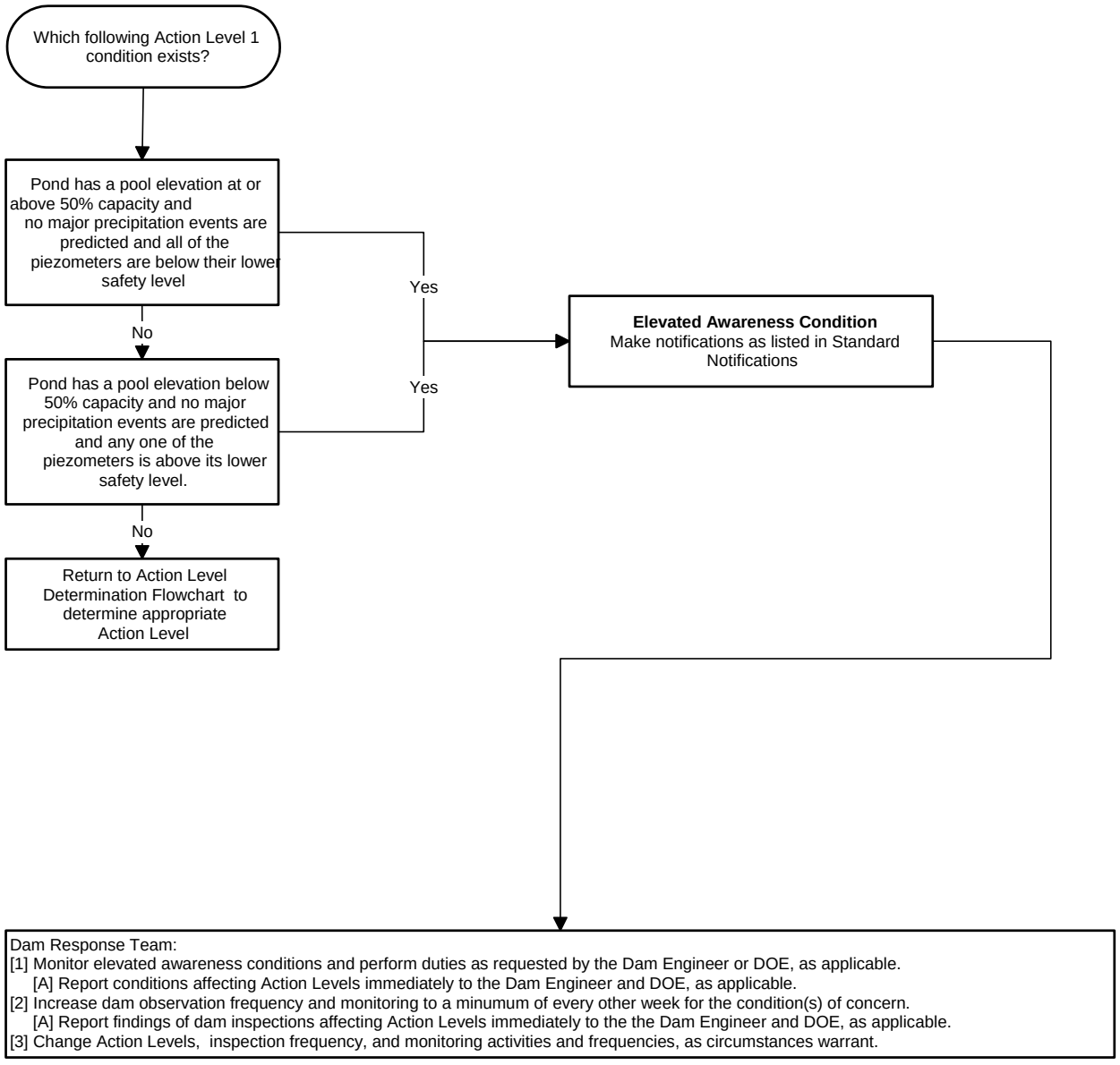


Dam Response Team:
[1] Coordinate with other members of the Dam Response Team and ensure assessment/evaluation of the on-scene situation.
[2] Establish safety guidance for personnel collecting samples or working on or below the dam.
[3] Monitor elevated awareness conditions and perform duties as requested by the Dam Engineer or DOE as applicable.
  [A] Report conditions affecting Action Levels immediately to the Dam Engineer and DOE as applicable.
[4] Implement "Emergency Actions" listed in Appendix G, as appropriate.
[5] Establish emergency discharge rates through the outlet or pumping station at a rate of approximately one foot of drawdown per day,.
  [A] Utilize computer modeling to calculate the flow rates necessary to meet the one foot/day drawdown rate.
  [B] Set pumps or outlet valves to calculated flowrates for the duration of the event or until revised flowrates are calculated.
[6] Provide and operate pumps and associated materials, or operate outlet valves, as required for pond transfers and/or discharges.
  [A] Begin discharge or transfer with acceptable sample results.
[7] Coordinate with off-Site agency field monitoring response teams.
[8] Increase dam observation frequency and monitoring to a minimum of every three days for the condition(s) of concern.
  [A] Report findings of dam inspections affecting Action Levels immediately to the Dam Engineer and DOE, as applicable.
[9] Implement environmental sampling as required in accordance with Appendix L, Environmental Water and Sediment/Soil Sampling, as required.
[10] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.
  [A] Evaluate conditions relative to failure modes listed in Appendix E in conjunction with the Dam Engineer and Consulting Engineer (if necessary).
  [B] Coordinate on-Site inspection by the State Engineer's Office to assess the situation and provide recommendations, as appropriate
[11] Change Action Levels, drawdown rates (if approved by the Dam Engineer), inspection frequency, and monitoring activities and frequencies, as circumstances warrant.

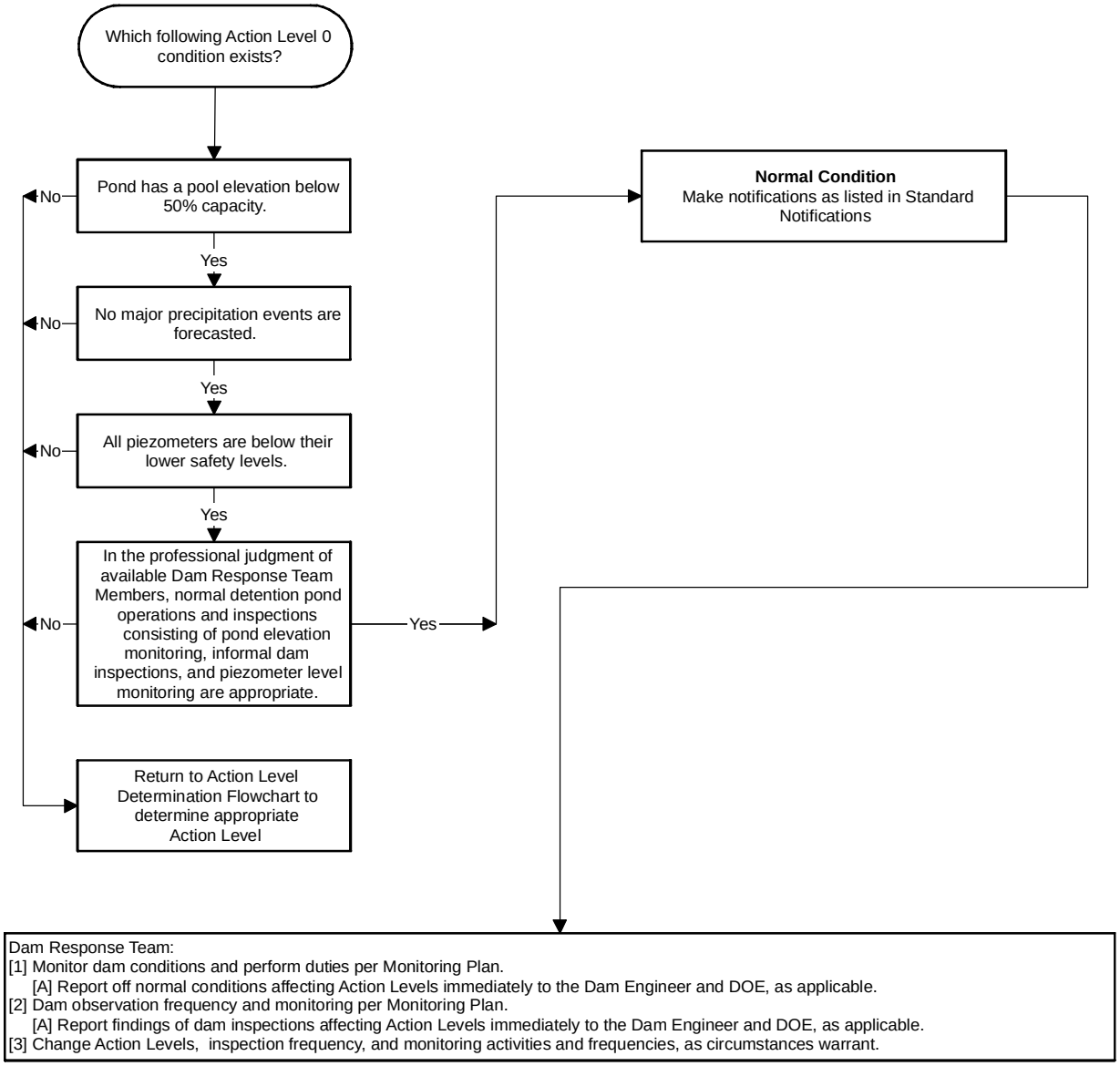
Action Level 2 Response



Action Level 1 Response



Action Level 0 Response Flowchart



This page intentionally left blank

Appendix G

Potential Problems and Emergency Actions

This page intentionally left blank

Potential Problems and Emergency Actions

The following are emergency actions that should be performed immediately for several problems that are considered to be serious and can affect the safety of dam. The recommended actions are potential solutions to emergency conditions that can be used to prevent the breaching of a dam. Perform these actions only when it is safe to do so.

Backcutting of the Spillway

1. Lower the water level by opening the outlet (and/or pumping). Continue to lower the reservoir until the State Engineer's personnel (SEO), or the dam engineer, determines that the conditions are safe.
2. Provide emergency protection at the eroding surface by placing plastic sheeting, riprap, or other erosion-resistant materials.
3. Mark where the spillway erosion is occurring. Monitor the rate of erosion (backcutting), and rate of flows from the spillway and outlets.

Cracking

1. Lower the water level by opening the outlet (and/or pumping). Continue until the water is below the cracking or as advised by the SEO or the dam engineer.
2. Attempt to block water movement into cracks by placing plastic sheeting over them.
3. Mark the extent of cracking with adequate stakes in order to monitor any increase or change in pattern. Document the observations.

Outlet Failure

1. Close the outlet gate to protect the embankment from washing out (piping).
2. Lower the water level by pumping, siphoning, or digging out a temporary spillway at the abutments. The temporary spillway should be located in an erosion-resistant material and/or at a flat slope to control the discharge velocities.
3. Monitor the outlet/embankment for settlement, occurrence of sinkholes, and muddy leakage. Observe outlet discharge for changes in flow (quantities). Document observations.

Overtopping

1. Open the outlet works completely to reduce overflow.
2. Divert inflow to the reservoir if possible.
3. Increase freeboard by placing sandbags, or other materials that will not wash away, on the crest of the dam.
4. Provide erosion protection for the crest and downstream slope using plastic sheeting and/or riprap.

5. Increase outflow by constructing temporary spillway at abutments. The spillway should be located in an erosion-resistant material and/or at a flat slope to control the discharge velocities.
6. Monitor the depth, duration, and location of overtopping. Watch for erosion, backcutting, and slides. Document the observations.

Piping

1. If the piping is not related to a problem with the outlet works, open the outlet to its safe capacity to drawdown the reservoir. Divert inflow to the reservoir if possible. Increase outflow by constructing a temporary spillway at the abutments. The spillway should be located in erosion-resistant material and/or at a flat slope to control the discharge velocities.
2. If the entrance to the leak can be found in the reservoir (whirlpool), on the embankment or abutments (sinkhole), try to plug it with whatever materials are available, such as plastic sheeting, hay bales, mattresses, etc.
3. Construct a reverse filter (large rock to finer material) over the exit area to trap fine materials from washing out the embankment.
4. Monitor the leakage/piping conditions. Measure the rate of leakage and the clarity of the water (muddy looking). Document the observations.

Saturation of the Embankment/Abutments (Seepage)

1. Lower the reservoir with the outlet works to a level determined by the dam engineer and/or approved by the SEO.
2. Monitor the conditions frequently for leakage, piping, cracking, and slides. Document the observations.

Settlement of Embankment

1. Determine whether the settlement is related to piping. If it is, see **Piping**.
2. Survey the existing monuments to determine the amount and rate of settlement. Install measurement points if necessary. Document the observations.
3. If the settlement is greater than 1 foot, lower the reservoir with the outlet works to a level determined by the dam engineer and approved by the SEO.

Sinkhole

A sinkhole is an indication of piping. See **Piping**.

Slides

1. Lower the reservoir with the outlet works to a level determined by the dam engineer and/or approved by the SEO. If the slide is on the upstream slope, consult with the dam engineer on the safe rate of drawdown.
2. If the outlet works is blocked/damaged by the slide, lower the reservoir using pumps, siphons, or construct temporary spillways at the abutments. See **Outlet Failure**.

3. Stabilize the toe of the slide (downstream slope) by constructing a berm with additional soil and rock. If there is significant leakage (muddy), construct a reverse filter. See **Piping**.
4. Monitor settlement, rate of movement, and extent of slide. See **Settlement of Embankment**. Document observations.

Wave Erosion of Embankment

1. Lower the reservoir at a safe rate with the outlet works to a level below the damaged area.
2. Restore any freeboard that may be lost using sandbags.
3. Place suitable-sized riprap on the damaged area in an emergency by whatever means necessary (dumping) to stop erosion.

Mark the damaged areas with stakes and monitor the situation. Document the observations.

Piezometer Levels

Piezometer levels are an indicator of the level of saturation of the dam embankment. See **Saturation of the Embankment/Abutments**.

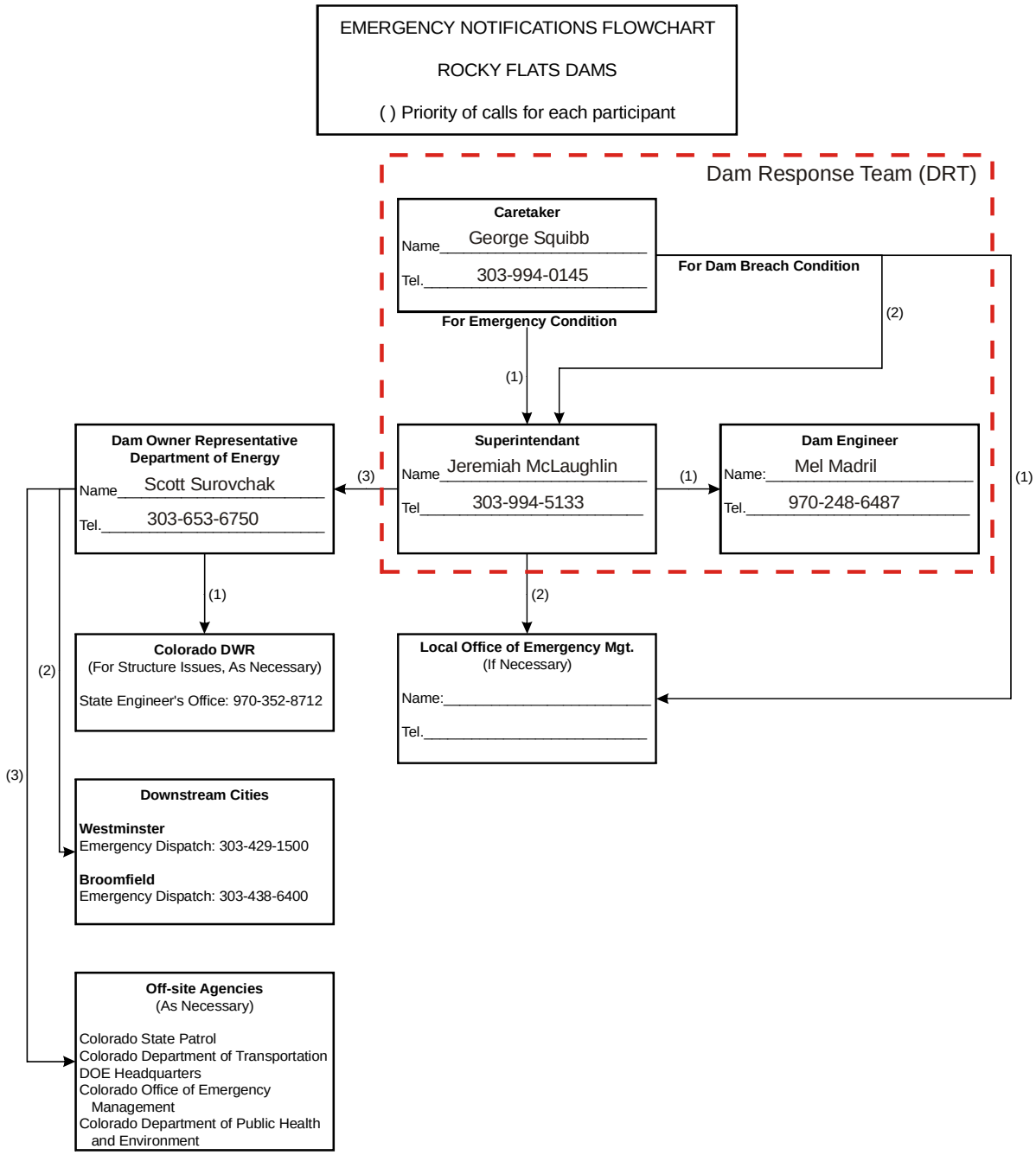
This page intentionally left blank

Appendix H

Emergency Notifications Flow Chart

This page intentionally left blank

Emergency Notifications Flow Chart



Note: Flow chart indicates minimum notifications that should be made and ideal persons to make notifications. Failure to reach personnel shown as responsible for making required notification does not eliminate necessity for making notification. In such case, responsibility for making notifications should be delegated to other personnel.

This page intentionally left blank

Appendix I

Contacts Directory and Standard Notifications

This page intentionally left blank

Table I−1. Contacts Directory and Standard Notifications

Department/ Agency	Contact Name	Contact Numbers	Email and/or address
Stoller Legacy Management	George Squibb	(W) 720-377-9675 (M) 303-994-0145 (H) 303-478-8568 (Fax) 720-377-3829	george.squibb@gjo.doe.gov
Stoller Legacy Management	Jeremiah McLaughlin	(W) 720-377-9676 (M) 303-994-5133 (H) 303-886-4771 (Fax) 720-377-3829	jeremiah.mclaughlin@gjo.doe.gov
Site Dam Engineer Stoller Legacy Management	Mel Madril	(W) 970-248-6487 (H) (Fax)	mel.madril@gjo.doe.gov
U.S. Department of Energy	Scott Surovchak	(W) 720-377-9682 (M) 303-653-6750 (Fax) 720-377-3829	scott.surovchak@lm.doe.gov

Contractors	Contact Name	Contact Numbers	Email and/or address
Engineering		(W) (H) (Fax)	
Construction		(W) (H) (Fax)	
Diving		(W) (H) (Fax)	

Off-Site Agencies	Contact Name	Contact Numbers	Email and/or address
City of Broomfield	Public Works	(W) 303-438-6360 (H) (Fax)	
City of Westminster	Public Works	(W) 303-430-2400 (H) (Fax)	
Colorado Department of Public Health and Environment	Carl Spreng	(W) 303-692-3358 (H) (Fax) 303-759-5355	carl.spreng@state.co.us
Office of State Engineer	Mike Hammer	(W) 970-352-8712 (H) (Fax) 970-892-1816	
Jefferson County	Mark Gutke	(W) (H) (Fax) 303-271-4905	
U.S. Environmental Protection Agency	Vera Moritz	(W) 303-312-6981 (H) (Fax) 303-312-6067	moritz.vera@epa.gov
Division of Wildlife	Thomas Nesler	(W) 303-291-7461 (H) (Fax) 303-291-7114	tom.nesler@state.co.us
Rocky Flats Stewardship Council	Rik Getty	(W) (H) (Fax) 303-412-1211	rgetty@rfclog.org

This page intentionally left blank

Appendix J

Inundation Map

This page intentionally left blank

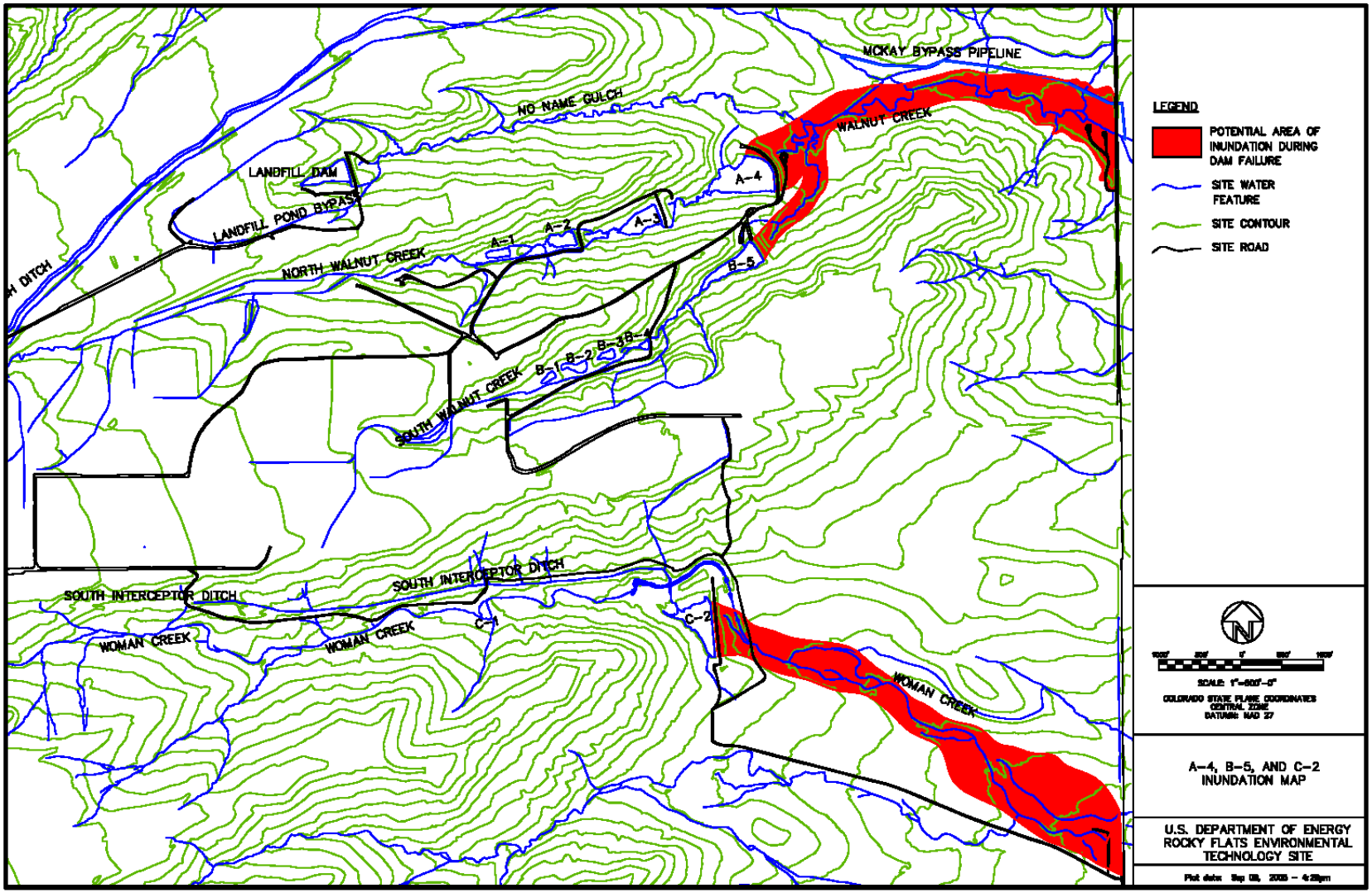


Figure J−1. Inundation Map for A-4, B-5, and C-2

This page intentionally left blank

Appendix K

Schematic for Current Flow and Water Transfer Network at Rocky Flats

This page intentionally left blank

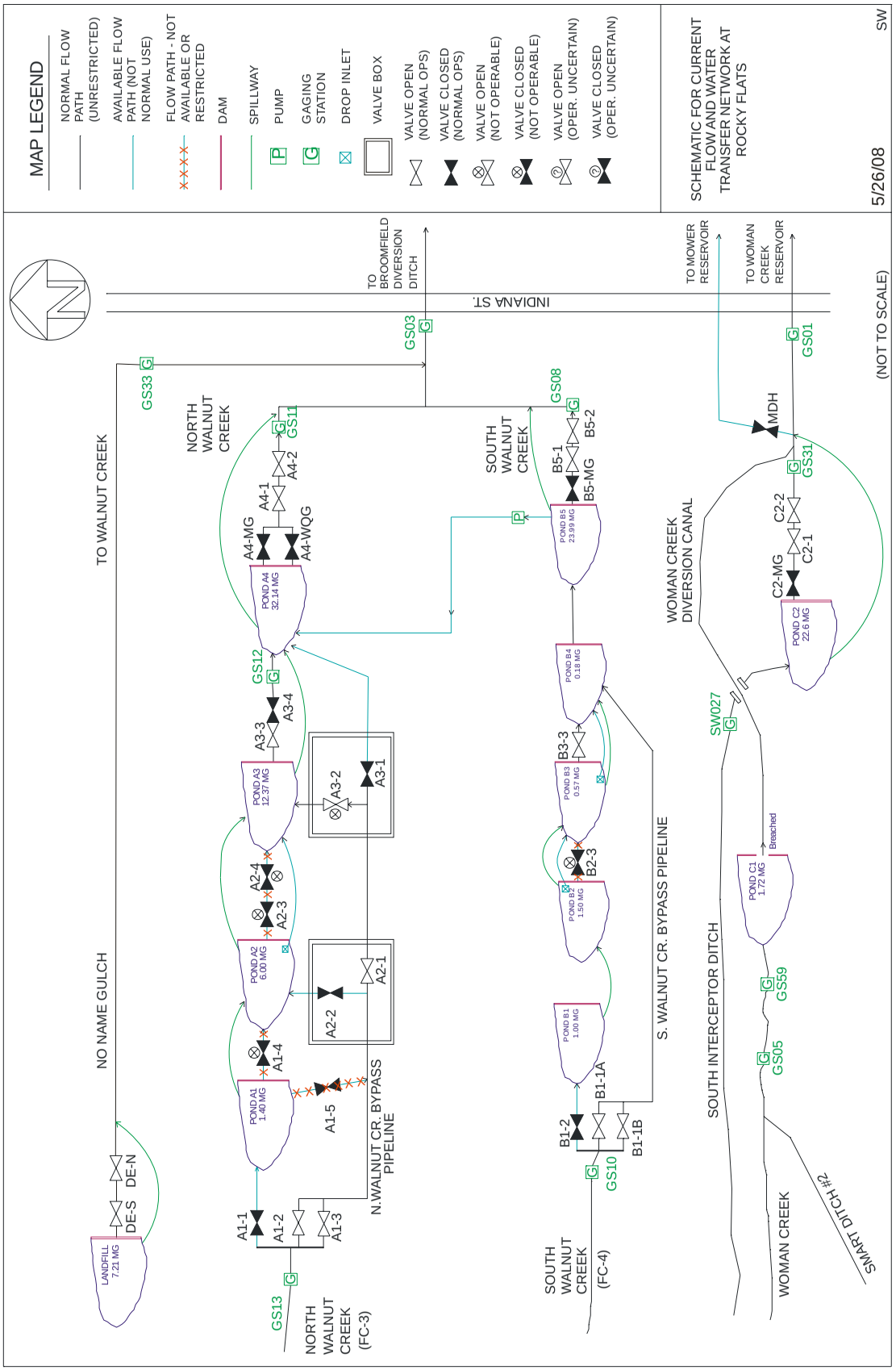


Figure K−1. Schematic for Current Flow and Water Transfer Network

Table K-1. Dam Drawings

The table below lists the drawings pertaining to the configuration of the dams that are not included in this document.

Series#	Numbers	Date	Description
24961	1 - 16	1972	Original Design Drawings for A-1, A-2, B-1, B-2, B-3, B-4, C-1
27038	1 - 10	1974	Original Design Drawings for A-3
27318	1 - 6	1974	Original Design Drawings for the Landfill Dam
27165	210 - 216	1978	Original Design Drawings for A-4
27165	220 - 225	1978	Original Design Drawings for B-5
27165	230 - 236	1978	Original Design Drawings for C-2
28895	001 - 016	1984	B-5 slope repair and modifications
39873	001 - 021	1997	Capacity study and topography
50320	0100 - 0102	1992	B-1 Rehabilitation
51043	100 - 101	1994	B-2 and B-4 Toe Blankets
51505	0001 - 0004	2000	A-1 and B-2 outlet modifications
51420	0001 - 0011	1996	A-4 outlet modifications
51420	0021 - 0030	1998	B-5 outlet modifications
51784	0101 - 0105	2004	C-1 stop log installation and outlet removal
51420	0051 - 0056	2005	C-2 outlet modifications

Appendix L

Environmental Water
and
Sediment/Soil Sampling

This page intentionally left blank

Environmental Water and Sediment/Soil Sampling

Water samples may be collected at the initiation of or during an unplanned release or emergency discharge (see table below). In some instances, pre-discharge sample collection may have occurred prior to the declaration of a new action level, and the initiation of an unplanned release or emergency discharge. The intent is to conduct sampling as required by the Rocky Flats Legacy Management Agreement, provided that sampling activities can be conducted safely. If the unplanned release includes pond sediments or soils, analysis of these materials may be performed for the items listed in the following table:

Water Samples		Soil and Sediment Samples		
Water Quality Parameters		**Radiochemical Parameters (Total)**		
Nitrate + Nitrite as N		Americium-241		
		Plutonium-239,240		
		Uranium-233,234		
		Uranium-235		
Radiochemical Parameters (Total)		Uranium-238		
Americium-241				
Plutonium-239,240				
Uranium-233,234				
Uranium-235				
Uranium-238				

This page intentionally left blank